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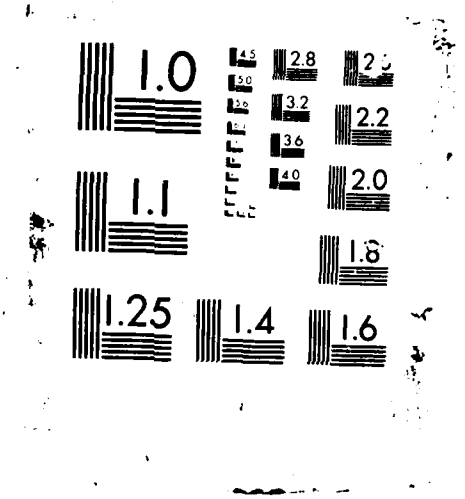
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Kaplansky, Irving and Karp, Richard

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17 COSATI CODES		
FIELD	GROUP	SUB-GROUP

18 SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
Parallel computation, computational complexity, distributed protocols, randomized algorithms, fault-tolerant computing.

19 ABSTRACT (Continue on reverse if necessary and identify by block number)

The Berkeley Mathematical Sciences Research Institute (MSRI) featured a program in computational complexity during 1985-86. A substantial part of the program was devoted to parallel and distributed computing. Support for this part of the program was obtained from the present Army contract and a similar grant from the Air Force. Personnel supported on this grant were Leslie Valiant of Harvard University and postdoctoral fellows David Shmoys and Umesh Vazirani. A workshop on parallel and distributed computing was held from May 19 to May 23, 1986 and drew 141 participants.

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Final Technical Report to the U.S. Army Research Office on Contract No. DAAG29-85-K-0138.

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Attachments

Poster for the workshop.
List of participants.
Program of the workshop.
Form 1473.

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Final Technical Report to the U.S. Army Research Office on Contract No. DAAG29-85-K-0138

1. Summary. This contract was entitled "Parallel and distributed computing". It provided $46,000 in partial support of the yearlong program on Computational Complexity held at the Berkeley Mathematical Sciences Research Institute during 1985-86. This was combined with a similar grant for $92,000 from the Air Force Office of Scientific Research and with funding of MSRI from the National Science Foundation to budget the total program on Computational Complexity at approximately $600,000.

Intially, the co-principal investigators were Richard Karp and Calvin Moore. When, on July 1, 1985, Professor Moore left his post as Deputy Director of MSRI to become a Vice-President of the University of California system, Irving Kaplansky (the current Director of MSRI) replaced him. Professor Karp provided the scientific direction and Professor Kaplansky the administrative support.

David Shmoys and Umesh Vazirani were postdoctoral fellows supported by the contract; Leslie Valiant of Harvard University was a senior visitor for four months (April 15 - July 15, 1986).

From May 19 to May 23, 1986 MSRI hosted a Workshop on Parallel and Distributed Computing, supported by the Army contract and the Air Force grant.

2. Report on the Scientific Work.

Leslie Valiant

Leslie Valiant worked on the problem of inferring a rule or computer program from examples of its behavior. The problem has applications in fields such as artificial intelligence and pattern recognition. The mathematical problem is to identify classes of rules or programs that can be inferred in a provably convergent sense from reasonably few examples. At the MSRI Workshop on Complexity of Parallel and Distributed Computation he presented a talk entitled "Learning Algorithms for Connectionist Models". He also spoke at UC Irvine on "A Theory of the Learnable".

David Shmoys

David Shmoys investigated protocols for shared decision making in a distributed network of processors, some of which may be faulty. Some of this work was presented in C. Dwork, D. Shmoys and L. Stockmeyer, "Flipping Persuasively in Constant Expected Time," Proceedings, 27th IEEE Symposium on Foundations of Computer Science, pp. 222-232, 1986.

Umesh Vazirani

Umesh Vazirani in joint work with Vijay Vazirani, investigated the computation power of randomized algorithms when the generator of random bits is imperfect, and may even be controlled by an intelligent and devilish adversary. It is only required that, for every bit generated, the probability of generating a 1 is uniformly bounded away from both zero and one. The main result of this investigation is that any problem that can be solved in polynomial time using a perfect generator of unbiased, independent bits can also be solved in polynomial time using an imperfect generator.

In the reference cited below, Vazirani and his co-authors developed an efficient randomized algorithm for constructing a maximum matching in a graph.

K. Mulmuley, U.V. Vazirani and V.V. Vazirani, "Matching is as Easy as Matrix Inversion", MSRI Preprint 06318-86.

3. Report on the Workshop.

A workshop on the complexity of parallel and distributed computation was held at MSRI from May 19 to May 23, 1986. The workshop had 21 speakers and 141 participants; their interests ranged from practical questions about the architecture of parallel and distributed systems to highly theoretical questions about the complexity of parallel computation. A panel discussion was held on the topic "Bridging the Gap Between the Theory and Practice of Parallel and Distributed Computing".

The main focus of the workshop was a set of mathematical and algorithmic issues that underlie the efficient use of the massively parallel computers that are just beginning to come into use. Several of the lectures were concerned with efficient algorithms for such computers. Other lectures were concerned with the problems of synchronization, load-sharing, and communication between processors in such systems. A third major theme was the reliable operation of such systems in the presence of faulty processors.

The total budget for the workshop was $18,000, of which $2,850 came from the Army contract, and $15,150 from the Air Force grant.

The participants supported by the Army contract were as follows:

Dharma Agrawal	$350
Baruch Awerbuch	650
Gianfranco Bilardi	650
Mo-Suk Chow	350
Patrick Dymond	400
Charles Seitz	450
	$2,850

Appended as attachments to this report are the widely distributed poster for the workshop, the complete list of participants, and the program.

4. Financial Report.

Salary (Valiant)	$19,000
Postdoctoral fellowships:	
Shmoys	8,500
Vazirani	8,500
Travel allowances:	
Shmoys	656
Vazirani	564
Workshop	2,850
Fringe Benefits	900
Health Insurance (Vazirani)	780
Telephone	760
Supplies, preprints	1,240
Technical typing	1,300
Computer charges	950
	$46,000

Workshop on
PARALLEL AND DISTRIBUTED COMPUTATION
May 19-23, 1986
at the
MATHEMATICAL SCIENCES RESEARCH INSTITUTE
BERKELEY, CALIFORNIA

As part of its yearlong 1985-86 program on Computational Complexity, the Mathematical Sciences Research Institute will host a one-week workshop on the complexity of parallel and distributed computation, May 19-23, 1986. The organizing committee consists of R.M. Karp (chairman), H.T. Kung, Michael Rabin, and J.T. Schwartz. One of the principal aims of the workshop is to bring mathematicians and computer scientists working on the theoretical aspects of these subjects into contact with numerical analysts and computer architects involved in the design and use of parallel and distributed computer systems. Major topics addressed at the workshop will include: complexity of parallel computation, combinatorial and numerical parallel algorithms, realization of parallel algorithms in hardware, abstract models of parallel computation, architecture of parallel computers, concurrency control, randomization in parallel and distributed computing, routing algorithms, and fault-tolerant computation in distributed systems.
In addition to the program committee, the following have been invited to participate:

R. Anderson	D. Hillis	E. Mayr	L. Synder
B. Awerbuch	E. Kaltofen	G. Miller	G.W. Stewart
A. Borodin	R. Kannan	C. Moler	L. Stockmeyer
T. Chan	D. Kozen	K. Mulmuley	H. Stone
A. Chandra	D. Kuck	J. Oliger	R. Strong
M. Chandy	R. Ladner	V. Pan	R. Tarjan
R. DeMillo	L. Lamport	C. Papadimitriou	C. Thompson
C. Dwork	E. Lawler	G. Pfister	J. Ullman
P. Dymond	F.T. Leighton	N. Pippenger	E. Upfal
F. Fich	C. Leiserson	F. Preparata	L. Valiant
M. Fischer	R. Lipton	J. Reif	U. Vazirani
Z. Galil	M. Luby	W. Ruzzo	V. Vazirani
J. von zur Gathen	F. Luk	C. Seitz	U. Vishkin
W.M. Gentleman	N. Lynch	D. Shmoys	A. Wigderson
J. Halpern	G. Mago	M. Sipser	A. Yao

The workshop will be held at the Institute's new building at 1000 Centennial Drive. Shuttle bus service will be provided from the central campus area.
The mathematical sciences community is warmly invited to attend. Additional, more detailed information will be sent to people indicating a desire to come to the workshop. There will be a limited amount of money available to provide partial support for people wishing to attend and participate. New and recent Ph.D.'s are encouraged to apply. Requests for financial support should be received by April 1, 1986. Address inquiries concerning the workshop to *Program Committee, Parallel and Distributed Computing, Mathematical Sciences Research Institute, 1000 Centennial Drive, Berkeley, California 94720.* Funding for the conference is provided by the Army Research Office and the Air Force Office of Scientific Research, in cooperation with the Office of Naval Research.

Please Post

COMPLEXITY ASPECTS OF PARALLEL AND DISTRIBUTED COMPUTING

May 19-23, 1986

Participant List

Selim Akl	Queen's University, SRI, UC Berkeley
Richard Anderson	MSRI
Baruch Awerbuch	MIT
Sara Baase	UC Berkeley
Donald Beaver	Harvard
Marshall Bern	UC Berkeley
Gianfranco Bilardi	Cornell
Adam Bojanczyk	Washington University
Michael Campbell	UC Los Angeles
Larry Carter	UC Berkeley & IBM
Tony Chan	Yale, RIACS
Chandran	University of Maryland
Paul Chew	Dartmouth
Mo-suk Chow	Northeastern University
D. Coan	Floating Point Systems
Richard Cole	NYU
Harold Cox	
Narsingh Deo	Washington State University
Alvin Despain	UC Berkeley
Randall Dougherty	CALTECH
Cynthia Dwork	IBM
Jeanne Ferrante	UC Berkeley & IBM
Faith Fich	University of Washington

COMPLEXITY ASPECTS OF PARALLEL AND DISTRIBUTED COMPUTING

May 19-23, 1986

Participant List

Sally Floyd	UC Berkeley
Lance Fortnow	UC Berkeley
Zvi Galil	Columbia, Tel-Aviv Univ.
Max Garzon	MSU
Phil Gibbons	UC Berkeley
Andrew Goldberg	MIT
Shafi Goldwasser	MIT
P.S. Gopalakrishnan	University of Maryland
Stuart Haber	Columbia
Ramsey Haddad	Stanford
Joe Halpern	IBM
Lisa Hellerstein	UC Berkeley
David Helmbold	Stanford
L. Higham	University of British Columbia
Russell Hinds	UC Berkeley
Dorit Hochbaum	MSRI & UC Berkeley
Joan Hutchinson	Smith College
Amos Israeli	Harvard
Erich Kaltofen	Rensselaer Polytechnic Inst.
Paris Kanellakis	Brown University
Richard Karp	MSRI
Simon Kasif	Johns Hopkins
Zvi Kedem	Courant
Sam Kim	Rensselaer Polytechnic Inst.

COMPLEXITY ASPECTS OF PARALLEL AND DISTRIBUTED COMPUTING

May 19-23, 1986

Participant List

Valerie King	UC Berkeley
Richard King	Kestrel
Philip Klein	MIT
Dexter Kozen	Cornell
Mark Krentel	Cornell
Danny Krizane	Harvard
Richard Ladner	MSRI & University of Washington
Gad Landau	Tel Aviv University
Charles Leiserson	MIT
Jan Karel Lenstra	CWI, Amsterdam
Nick Littlestone	UC Santa Cruz
Laszlo Lovasz	MSRI
Anna Lubiw	UC Berkeley
Michael Luby	University of Toronto
George Lueker	UC Irvine
Frank Luk	Cornell
Stephen Lundstrom	MCC
Wolfgang Maass	University of Illinois, Chicago
Yoni Malachi	IBM Almaden
Michael Matsko	UC Berkeley
Jill Mesirov	Thinking Machines Corp.
Silvio Micali	MIT
Zevi Miller	UC Berkeley
Gary Miller	USC

COMPLEXITY ASPECTS OF PARALLEL AND DISTRIBUTED COMPUTING

May 19-23, 1986

Participant List

Ketan Mulmuley	UC Berkeley
Simeon Naor	UC Berkeley
Lena Nekluobova	Thinking Machines Corp.
Mark Newman	MIT
Noam Nisan	UC Berkeley
Frank Olken	Lawrence Berkeley Lab.
Victor Pan	SUNY Albany
Haesun Park	Cornell
Ramamohan Patiu	Harvard
David Peleg	IBM San Jose
Nicholas Pippenger	IBM Almaden
Carl Ponder	UC Berkeley
Alex Pothen	Pennsylvania State
Harry Printz	CMU
Michael Rabin	Harvard, Hebrew Univ., MSRI
S. Rajasekaran	Harvard
Vijaya Ramachandran	University of Illinois, Urbana
John Reif	Harvard, MSRI
Ronitt Rubinfeld	UC Berkeley
Vlad Rutenburg	Stanford
Larry Ruzzo	Washington
Gary Sabot	Harvard
Miklos Santha	UC Berkeley
Uwek Sarkar	Stanford

COMPLEXITY ASPECTS OF PARALLEL AND DISTRIBUTED COMPUTING

May 19-23, 1986

Participant List

Carla Savage	North Carolina State
Cathy Schevon	Brown University
J. Schmidt	NYU
Rob Schreiber	Rensselaer Polytechnic Inst.
Ed Schweichel	San Jose State University
Charles Seitz	CALTECH
Amitabm Shah	Cornell
Deepak Sherlekar	University of Maryland
David Shmoys	MIT & MSRI
Alan Siegel	NYU
Janos Simon	University of Chicago
Barbara Simons	IBM San Jose
Michael Sipser	MSRI
Bruce Smith	
Rob Smith	MCC
L. Snyder	University of Washington
Danny Soroker	UC Berkeley
Helmut Stern	UC Berkeley
G.W. Stewart	University of Maryland
Larry Stockmeyer	IBM Almaden
Leen Stougie	UC Berkeley
Charle Swart	Oregon State University
Eva Tardos	MSRI
Robert Tarjan	Princeton & AT&T Bell Labs.

COMPLEXITY ASPECTS OF PARALLEL AND DISTRIBUTED COMPUTING

May 19-23, 1986

Participant List

Al Thaler	NSF
Athanasios Tsantilas	Harvard
Gyorgy Turan	University of Illinois, Chicago
Jeffrey Ullman	Stanford
Eli Upfal	IBM Almaden
Leslie Valiant	Harvard, MSRI
Umesh Vazirani	MSRI
H. Venkatewaran	University of Washington
Uzi Vishkin	Tel Aviv University
Paul Vitanyi	MIT
Jeff Vitter	MSRI, Brown Univ.
Joachim Von zur Gathen	University of Toronto
John Walker	Stanford
Greg Wasilkowski	Columbia
Avi Wigderson	MSRI
David Wolfe	UC Berkeley
Richard Wongkew	UC Berkeley
Henryk Wozniakowski	Columbia
Mihaly Yeveb	
Wei Young	University of Alabama
Moti Yung	Columbia
Yanjun Zhang	UC Berkeley

MATHEMATICAL SCIENCES RESEARCH INSTITUTE

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WORKSHOP ON
COMPLEXITY OF PARALLEL & DISTRIBUTED COMPUTATION
May 19-23, 1986

(All sessions will be held in the MSRI Lecture Hall.)

Monday, May 19

8:30 - 9:30	Arrival of Participants
9:30 - 9:40	Opening of the Workshop
9:40 - 10:30	Richard Anderson, MSRI A Random NC Algorithm for Depth-First Search
10:40 - 11:30	Uzi Vishkin, Tel Aviv University On Methods for Designing Parallel Algorithms
12:30 - 2:00	Lunch Break
2:00 - 2:50	John Reif, Harvard University and MSRI Efficient Parallel Algorithms - Theory and Practice
3:15 - 4:00	Tea
4:00 - 4:50	Gary Miller, University of Southern California Workload Balancing in the Design of Processor-Efficient Parallel Algorithms

Tuesday, May 20

9:00 - 9:50	Gianfranco Bilardi, Cornell University Bitonic Sorting in $O(\log^2 n)$ Time with $O(n/\log n)$ Processors
10:00 - 10:50	Nicholas Pippenger, IBM Almaden Research Center Parallel Comparison Problems
10:50 - 11:30	Coffee Break
11:30 - 12:20	Ketan Mulmuley, University of California at Berkeley Parallel Computation in Linear Algebra
12:20 - 2:00	Lunch Break
2:00 - 2:50	Franklin Luk, Cornell University Parallel Algorithms for Signal Processing
3:15 - 4:00	Tea
4:00 - 4:50	Gilbert Stewart, University of Maryland Determinacy - Its Uses and Limitations
6:30 -	Heyns Room, Faculty Club Reception for all participants

Wednesday, May 21

9:00 - 9:50	Baruch Awerbuch, MIT Optimal Dynamic Deadlock Resolution Protocols
10:00 - 10:50	Joseph Halpern, IBM Almaden Research Center Analyzing Distributed Systems via Knowledge
10:50 - 11:30	Coffee Break
11:30 - 12:20	Silvio Micali, MIT How to Compile Protocols for Reliable Players to Equivalent Fault-Tolerant Protocols
12:20 - 2:00	Lunch Break
2:00 - 2:50	Eli Upfal, IBM Almaden Research Center On the Relation Between Desirable and Feasible Models for Parallel Computation
3:15 - 4:00	Tea
4:00 - 4:50	Michael Rabin, Harvard University, Hebrew University, and MSRI Randomized Synchronization Primitives for Parallel Computers

Thursday, May 22

9:00 - 9:50	Larry Snyder, University of Washington Type Architectures
10:00 - 10:50	Charles Seitz, California Institute of Technology Low Latency Message-Passing Techniques for Concurrent Computers
10:50 - 11:30	Coffee Break
11:30 - 12:20	Charles Leiserson, MIT VLSI Theory and its Relation to Parallel Supercomputing
12:20 - 2:00	Lunch Break

Thursday, May 22 continued

2:00 - 3:15	Panel Discussion: Closing the Gap Between the Theory and Practice of Parallel and Distributed Computation Richard Karp, University of California at Berkeley and MSRI Charles Leiserson, MIT Michael Rabin, Hebrew University, Harvard University, and MSRI Charles Seitz, California Institute of Technology Larry Snyder, University of Washington
3:15 - 4:00	Tea
4:00 - 5:00	Continuation of Panel Discussion

Friday, May 23

9:00 - 9:50	Avi Wigderson, MSRI Lower Bounds in Parallel Computation
10:00 - 10:50	Jeffrey Ullman, Stanford University Parallel Complexity of Logic Programs
11:00 - 11:50	Leslie Valiant, Harvard University and MSRI Learning Algorithms for Connectionist Models

END OF WORKSHOP

PLEASE POST

END

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